USGS
science for a changing world

# Mineral Industry Surveys

**For information, contact:**
John Jorgenson, Bismuth Commodity Specialist
U.S. Geological Survey
989 National Center
Reston, VA 20192
Telephone: (703) 648-4912, Fax: (703) 648-7757
E-mail: jjorgenson@usgs.gov

Shonta E. Osborne (Data)
Telephone: (703) 648-7971
Fax: (703) 648-7975
E-mail: sosborne@usgs.gov

**Internet:** http://minerals.usgs.gov/minerals

## BISMUTH IN THE FOURTH QUARTER 2003

Total bismuth consumption in the United States for the fourth quarter was 608,000 kilograms, which was unchanged from consumption in the third quarter, according to estimates compiled by the U.S. Geological Survey. As a result of an ongoing USGS analysis of the bismuth market that was begun during the second quarter of 2003, quarterly end use patterns for the second half of 2003 contain some different assumptions from those of previous quarters (table 1). Therefore, consumption and end use data for the second half of 2003 differ significantly from those of the first half. Accordingly, the consumption breakdown of bismuth for the second half of 2003 was 46% for metallurgical additives in alloying and galvanizing; 29% for fusible alloys, solders, and ammunition; 24% for chemical and pharmaceutical uses; and 1% for research and other miscellaneous uses.

The New York dealer price for bismuth, as published in Platts Metals Week, ended the third quarter within a price range of $2.90-$3.10 per pound. During the first week in October the price range dropped and widened to $2.65 - 2.95 per pound. The following week the price range dropped slightly to $2.60-$2.90 per pound and remained steady through the end of the year.

**Reserves.—**Fortune Minerals Limited (Canada) drilled additional holes in the central part of its NICO gold-cobalt-bismuth deposit in the Northwest Territories. The drilling program exceeded expectations with a number of high-grade intersections, some of which remain open for future expansion of reserves (Metal-Pages, 2003a§[1]). The company announced successful completion of a Can$3.7 million financing package, part of which will fund feasibility studies for the NICO deposit (Fortune Minerals Limited, 2003).

**Research and Uses.—**Research and development continued on lead-free solders for electronics applications, a general discussion of which can be found in a recent article in Advanced Materials & Processes (Bastow, 2003). In a paper prepared by Next Generation Environment-Friendly Soldering Technology (EFSOT), it was estimated that although overall lead consumption would be reduced by only 0.8%, overall bismuth consumption would increase by about 25% with a move to lead-free solders (Deubzer, 2004§).

Work was also performed by EFSOT scientists on the oral toxicity, intratracheal toxicity, and carcinogenicity of lead-free metals. This preliminary study shows bismuth to have acute or single dose toxicity equal to that of antimony, indium, lead, and silver. The oral "no observed affect level" or chronic toxicity level, however, was very low. Intratracheal administration of bismuth to laboratory rats showed no effects on measured indicators. Bismuth was found not to be mutagenic in initial tests and therefore probably not carcinogenic, and on a chromosome aberration test the metal showed mutagenicity in only 6% of the tests with a dose of 5 gram per milliliter (Sato, 2004§).

Superconductive Components, Inc. (Ohio) was awarded $518 thousand by the U.S. Department of Energy to determine the feasibility of producing bismuth-strontium-calcium-copper oxide (BSCCO) superconducting wires. These BSCCO wires would be used for very high field magnets beyond 12 Tesla at temperatures of 4.2 degrees Kelvin (Advanced Materials & Processes, 2003). This Phase II Small Business Innovation Research grant is in addition to the $105 thousand granted for an earlier study and will also be used to investigate the commercial-scale viability of the work (Superconductive Components, Inc., 2003).

**Substitution.—**Work continues on finding an environmentally friendly alternative to lead that is less expensive than bismuth for use in small arms ammunition. Mitsubishi Materials has developed a new composite material with the same density and hardness as lead. This new tungsten-based material is expected to overcome some of the problems related to bismuth in lead-free hunting ammunition (Metal-Pages, 2003c§).

**Production.—**In China, the world's leading supplier of tin, Yunnan Tin Corp., plans to increase bismuth production by 30% in 2003 to 130 metric tons (t) (Mining Journal, 2003). Efforts by China to charge higher prices for bismuth to cover adjusted rebate reductions have failed. Buyers have had no problem sourcing material at existing price levels (Metal-Pages, 2004b§).

Industrias Peñoles, S.A. de C.V. (Mexico), the largest single producer of bismuth in the world, produced 788 t of bismuth in the first three quarters of 2003. At this rate Peñoles will be

[1]References that include a section mark (§) are found in the Internet References Cited section.

slightly short of its 2002 bismuth production of 1103 t. Lack of lead concentrates in 2003 forced the company to rely on outside sources of feed (Industrias Peñoles, S.A. de C.V., 2004§).

Japanese production of bismuth for the first half of 2003, 231 t, was slightly above the production level for the first half of 2002. Stocks at the end of June were at 44.7 t (Roskill's Letter from Japan, 2003).

Teck Cominco, Limited's 2003 production and sales of byproduct bismuth increased from 2002 levels, which reflected lost production in 2002 owing to a full plant shutdown in August (Metal-Pages, 2003b§).

**Consumption.—**The world bismuth market remained relatively quiet in the fourth quarter with demand for bismuth fairly stable (Mining Journal, 2003). The only major growth area reported was its use as a replacement for lead. Lead-free applications, which are particularly being emphasized in Japan, include copper alloys in pipes and faucets, pigments, solders, and uses in the industrial oil sector. Indications are that worldwide demand for bismuth is growing at about 5% per year (Metal-Pages, 2004a§).

According to the Bismuth Producers Association (Brussels, Belgium), the use of bismuth in pigments has made Ciba Specialty Chemicals (Switzerland) and BASF Aktiengesellschaft (Germany) the top consumers of bismuth in Europe. Additionally, Mexico has increased its domestic consumption of bismuth in the galvanizing of steel and production of bismuth salts (Yves Palmieri, Bismuth Producers Association, oral commun., January 23, 2004).

## References Cited


Advanced Materials & Processes, 2003, Technical bulletins: Advanced Materials & Processes, v. 161, no. 12, December, p. 12.

Bastow, Eric, 2003, Solder families and how they work: Advanced Materials & Processes, v. 161, no. 12, December, p. 23-29.

Fortune Minerals Limited, 2003, Fortune Minerals successfully completes $3,712,500 financing: London, Ontario, Canada, Fortune Minerals Limited news release, November 28, 1 p.

Mining Journal, 2003, Minor metals in October: Mining Journal, v. 341, no. 8760, October 31, p. 353.

Roskill's Letter from Japan, 2003, Non-ferrous metals—Japanese production in the first half of 2003: Roskill's Letter from Japan, no. 326, October, p. 2.

Superconductive Components, Inc., 2003, Superconductive Components, Inc. awarded research contract by U.S. Department of Energy: Columbus, OH, Superconductive Components, Inc. press release, October 6, 1 p.


## Internet References Cited


Deubzer, Otmar, et al, 2004 (January 15), EFSOT (Next Generation Environment-Friendly Soldering Technology)—Recycling and resource consumption, accessed February 3, 2004, at URL http://www.efsot-europe.info.

Industrias Peñoles, S.A. de C.V., 2004, Industrias Peñoles, S.A. de C.V. web site, accessed February 4, 2004, at URL http://www.penoles.com.mx.

Metal-Pages, 2004a (January 23), Bismuth as usual for bismuth, accessed January 26, 2004, at URL http://www.metal-pages.com.

Metal-Pages, 2004b (January 30), Market roundup—Quieter markets but most prices remain firm, accessed February 2, 2004, at URL http://www.metal-pages.com.

Metal-Pages, 2003a (October 27), Fortune Mineral's Nico deposit reveals good Au, Co and Bi levels, accessed October 28, 2003, at URL http://www.metal-pages.com.

Metal-Pages, 2003b (October 23), Higher prices and production nearly quadruple Teck Cominco's Q3 profits, accessed October 27, 2003, at URL http://www.metal-pages.com.

Metal-Pages, 2003c (October 16), Mitsubishi develops tungsten based ammunition, accessed October 17, 2003, at URL http://www.metal-pages.com.

Sato, H., and others, 2004 (January 15), EFSOT (Next Generation Environment-Friendly Soldering Technology)—biological impact, accessed February 3, 2004, at URL http://www.efsot-europe.info.

TABLE 1
SALIENT BISMUTH STATISTICS[1]

(Kilograms unless otherwise specified)

| | | 2003 | | | | |
|---|---|---|---|---|---|---|
| | 2002 | First quarter | Second quarter | Third quarter | Fourth quarter | Year to date |
| Consumption | 2,230,000 | 431,000 e | 432,000 e | 608,000 e | 608,000 e | 2,080,000 e |
| Exports[2] | 131,000 | 24,500 | 36,000 | 26,700 | 10,700 [3] | 97,900 [4] |
| Imports for consumption | 1,930,000 | 499,000 | 569,000 | 671,000 | 352,000 [3] | 2,090,000 [4] |
| Price per pound, dealer, end of period | $3.20 | $2.70 | $2.95 | $2.70 | $2.60 | XX |
| Stocks, end of period, consumer | 88,800 | 133,000 e | 234,000 e | 133,000 e | 107,000 | XX |

eEstimated. XX Not applicable.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Comprises bismuth metal and the bismuth content of alloys and waste and scrap.

[3]Includes October and November only; December data were not available at the time of publication.

[4]December data were not available at the time of publication.

TABLE 2
BISMUTH METAL CONSUMED IN THE UNITED STATES, BY USE[1]

(Kilograms)

| | | 2003e | | | | |
|---|---|---|---|---|---|---|
| Use | 2002 | First quarter | Second quarter | Third quarter | Fourth quarter | Year to date |
| Chemicals[2] | 814,000 | 163,000 | 193,000 | 147,000 | 147,000 | 650,000 |
| Bismuth alloys[3] | 985,000 | 160,000 | 150,000 | 179,000 | 179,000 | 669,000 |
| Metallurgical additives | 383,000 | 103,000 | 83,400 | 278,000 | 278,000 | 742,000 |
| Other | 45,300 | 5,430 | 5,190 | 3,840 | 3,840 | 18,300 |
| Total | 2,230,000 | 431,000 | 432,000 | 608,000 | 608,000 | 2,080,000 |

eEstimated.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes industrial and laboratory chemicals, cosmetics, and pharmaceuticals.

[3]Includes fusible alloys, solders, and ammunition.

TABLE 3

U.S. EXPORTS OF BISMUTH METAL, ALLOYS AND WASTE AND SCRAP, BY COUNTRY[1]

(Kilograms)

| | | 2003[2] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | 2002 | First quarter | Second quarter | September | Third quarter | October | November | January-November |
| Belgium | 759 | 10,500 | -- | -- | -- | -- | -- | 10,500 |
| Brazil | 999 | 999 | 500 | -- | -- | -- | 300 | 1,800 |
| Canada | 47,700 | 1,470 | 1,260 | 5,510 | 14,200 | 379 | 5,640 | 22,900 |
| China | 3,000 | -- | -- | -- | -- | -- | -- | -- |
| Costa Rica | -- | 492 | -- | -- | -- | -- | -- | 492 |
| Dominican Republic | 500 | 270 | 849 | 59 | 816 | 142 | 87 | 2,160 |
| Egypt | -- | 340 | 108 | -- | -- | -- | -- | 448 |
| Germany | 6 | -- | 4 | -- | -- | -- | -- | 4 |
| Guatemala | -- | -- | 143 | -- | -- | -- | -- | 143 |
| Hong Kong | 332 | 61 | 48 | -- | -- | 29 | 17 | 155 |
| Hungary | -- | 136 | -- | -- | -- | -- | -- | 136 |
| Israel | 167 | -- | -- | -- | -- | -- | -- | -- |
| Japan | 66 | -- | 20,700 | 4,610 | 4,610 | -- | -- | 25,300 |
| Korea, Republic of | 4 | -- | -- | 180 | 180 | 316 | -- | 496 |
| Malaysia | 9,520 | -- | -- | -- | -- | -- | -- | -- |
| Mexico | 34,800 | 7,640 | 12,300 | 2,080 | 6,220 | 2,040 | 1,550 | 29,800 |
| Netherlands | 5,990 | -- | -- | -- | -- | -- | -- | -- |
| Peru | 4,000 | -- | -- | -- | -- | -- | -- | -- |
| Russia | 2,070 | 1,510 | -- | -- | -- | -- | -- | 1,510 |
| Singapore | 150 | -- | -- | -- | -- | -- | -- | -- |
| Thailand | -- | -- | -- | -- | -- | -- | 250 | 250 |
| United Arab Emirates | 58 | -- | -- | -- | -- | -- | -- | -- |
| United Kingdom | 20,600 | 1,110 | 1 | -- | 729 | -- | -- | 1,840 |
| Total | 131,000 | 24,500 | 36,000 | 12,400 | 26,700 | 2,910 | 7,840 | 97,900 |

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]December data were not available at the time of publication.

Source: U.S. Census Bureau.

TABLE 4

U.S. IMPORTS FOR CONSUMPTION OF BISMUTH METAL, BY COUNTRY[1]

(Kilograms, metal content)

| | | 2003[2] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | 2002 | First quarter | Second quarter | September | Third quarter | October | November | January-November |
| Bahamas, The | 684 | 219 | -- | 394 | 588 | -- | 527 | 1,330 |
| Belgium | 724,000 | 143,000 | 273,000 | 60,600 | 200,000 | 22,300 | 79,300 | 718,000 |
| Canada | 49,800 | 12,600 | 6,030 | 964 | 2,810 | -- | 25 | 21,500 |
| China | 393,000 | 153,000 | 84,400 | 62,300 | 203,000 | -- | 38,800 | 480,000 |
| Germany | 835 | 16,600 | 32,300 | -- | -- | -- | -- | 49,000 |
| Hong Kong | 58,500 | -- | 200 | -- | 51,300 | -- | 53,400 | 105,000 |
| Italy | 208 | 200 | -- | -- | -- | -- | -- | 200 |
| Japan | 3,150 | -- | -- | -- | -- | -- | -- | -- |
| Mexico | 518,000 | 128,000 | 127,000 | 54,100 | 145,000 | 54,000 | 40,000 | 494,000 |
| Netherlands | 102 | 15 | 21 | 3 | 19,600 | 19,200 | 18,600 | 57,400 |
| Peru | 19,500 | -- | -- | 135 | 135 | -- | -- | 135 |
| Spain | -- | -- | 200 | -- | 556 | -- | -- | 756 |
| United Kingdom | 163,000 | 45,600 | 45,000 | 16,700 | 47,500 | 15,100 | 11,200 | 164,000 |
| Total | 1,930,000 | 499,000 | 569,000 | 195,000 | 671,000 | 111,000 | 242,000 | 2,090,000 |

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]December data were not available at the time of publication.

Source: U.S. Census Bureau.